XEN Corporation

Department of Defense
Small Business
Innovation Research Program

Multimedia Technology Insertion into Open Systems Architecture (Compact Disc-interactive (CD-i))

Final Report (A002)

Contract Number: N00014-94C-0025

July 31, 1994

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Multimedia Technology Insertion into Open Systems Architecture

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Final Report (A002)

This report documents the findings in the Multimedia Technology Insertion into Open Systems Architecture project and documents the activities conducted from May 1, 1994, through July 31, 1994, (previous reports were dated February 28 and April 30, 1994.) The activities completed during this period include the following:

- Designed and developed a Compact Disc-interactive (CD-i) program titled *PSTS Components*..
- Completed research on the Operational use of the portable CD-i player.

• Designed and developed a CD-i program for the Scientific Officer

The project team designed and developed a CD-i program entitled *PSTS Components* for the Scientific Officer. Mr. Benjamin Curtis, Interactive Designer, gathered information for the informational content of the program, designed the features and structure of the program, and wrote the script. Mr. Curtis and Ms. Ellen D. Liebert, XEN Training Specialist, designed interface and

screen conventions for the program and Ms. Liebert designed the graphic "look" of the program.

At this point Ms. Liebert began developing the program screens, animation's, illustrations, and text overlays and acquiring digitized motion video assets. During this period, also, the scripts were reviewed by the Design Manager, Mr. Merrick Albert, and the Project Advisor, Mr. Edwin D. Nesburg, as well as by subject matter experts Mr. Denny Clark, Mr. Lenny Green, Mr. Richard Lebo, and Mr. Herbert Warren. Mr. Curtis made the required story board revisions. The text overlays in the program also required constant revision as screens were developed to accommodate the resolution requirements dictated by the medium. Text overlays were carefully worded to use as few words as possible while transmitting meaning and context even if the audio was not available or used.

As the scripts were finalized, Ms. Liebert and Mr. Curtis recorded the audio using the native audio recording capabilities of the Macintosh Quadra 840AV. As assets were completed they were converted into formats usable for CD-i authoring and transferred to the MediaMogul authoring/CD-i emulation system. Test scripts were authored to check the look and feel of the program.

After a sufficient number of the assets had been developed and converted, Ms. Melody Stahl, XEN CD-i Developer, began the MediaMogul authoring process. Authoring is an interactive process requiring constant coordination between members of the

development team as assets are tried, revised, converted, and tried again. After all of the multimedia media pieces were assembled, a CD-i disc was emulated in software and tested. Some revisions were made, mainly to refine visual and audio transition effects, and the disc was re-emulated and re-tested. Finally, a check disc was recorded and tested on the proposed delivery hardware: the Philips portable CD-i player, to check for over scanning and video safe area problems and to check for problems in authoring and visual design. Areas needing revision were identified. The required assets were modified, converted, and incorporated into the program. Three copies of the CD-i disc were recorded and delivered to the Scientific Officer on July 11, 1994.

- **Operational use of the portable CD-i player research:**

Mr. Robert Lambert, the principle researcher in the area of operational use of the portable CD-i player, conducted extensive research on the problem and compiled the following information.

The Problem

A persistent problem has faced our early-deployment forces since the first days of warfare: How does a commander obtain current, accurate intelligence in a forward-deployed unit under

adverse environmental conditions? A typical example of these units is the Sea-Air-Land Commandos of the United States Navy; the SEALs. A platoon of SEAL Combat Swimmers may disembark from a submerged vehicle, either a submarine or a Swimmer Delivery Vehicle (SDV), several miles out to sea. They must navigate to their objective, perform their mission and return to a pre-determined position for egress, all without detection by enemy forces. By the time they reach their objective intelligence may be hours or days old. In a quick-reaction force, hours are lifetimes, days mean casualties. These teams also gather intelligence; positions of beach obstructions, mines, emplacements, and enemy units. This data is recorded in much the same way it was during the era of the Scouts and Rangers and UDT units during World War II, Korea, and Vietnam. Positions are measured, obstructions are logged on a board which is taken to a rear unit, translated, and sent to units in need of the intelligence. This procedure is slow, prone to error, and ultimately places personnel at risk.

The Solution

The ideal tool to solve this problem would be one which:

- **is within the bounds of current technology**
- **is relatively inexpensive (disposable if possible)**

- is silent in use
- is stealthy in operation
- is easy to harden
- is impervious to environmental conditions
- is lightweight and easily packed
- is adaptable to any geographic area
- is able to receive incoming intelligence
- is able to gather new intelligence
- is tolerant of operator error
- is adaptable for many roles

The operational scenario is this. The team has a device which contains maps of the area under consideration stored in a digital form. These maps may be of different resolutions and types. This device also contains some form of computer which allows storage of known intelligence information. This computer contains code which allows this intelligence information to be overlaid on any map to show locations of obstructions, devices, or units. The operator would also be able to input new intelligence which would be stored within the device; for example, updating a mine position or logging a new mine. This requirement presupposes that the operator know his position. The unit must have few, if any moving parts to provide hardening. A unit of this type may be deployed from a moving ship or aircraft. Contact with the surface of the water imparts significant force to any device carried by the Combat Swimmer. The unit must

be completely sealed to prevent water from entering the device. It must be fully operational in this fully sealed configuration. The unit also contains some form of communication device which allows for reception of current intelligence and possibly transmission of gathered intelligence. The unit must be relatively portable and disposable.

This is a tall order, seemingly requiring years of research and development and millions of dollars, but because of the recent explosion of research into digital compression and high capacity storage devices, much of this research is readily available in the public domain. The initial search for a solution pointed toward Compact Disc-interactive (CD-i) technology as an alternative. Maps could be placed on CD-i discs which units would select prior to deployment (CD-i discs hold as many as 55,000 pictures on a single disc). CD-i players contain significant computing power to allow placement of intelligence overlays. They also typically have a computer port or connection which would allow connection of ancillary devices for communication, geolocation, or data input. CD-i players showed their potential for adaptability of use. Two problems would need to be addressed for CD-i use in the field: 1) hardening of the unit, and 2) making the unit environmental proof. The CD-i 350 player utilizes a finger tip mouse button for input and a built in screen 3" by 4" for display. It weighs approximately 9 pounds. The newest CD-audio technology for car CD players has proven to be relatively shock proof. This technology could be applied to the CD-i player and would allow for uncomplicated hardening of the unit.

Sealing a CD-i player to environmental hazards like sand and water, while keeping it operational may be required. This could be accomplished by placing the CD-i into a plastic sleeve which can be vacuum-sealed, allowing use in virtually all environmental conditions. These sleeves are removable and disposable allowing multiple uses of the unit where possible. The single unit price of the CD-i 350 base unit is currently less than $2600.

Communications for the CD-i unit can be enhanced by use of a Personal Digital Assistant (PDA). The PDA could provide the CD-i computer GPS information as well as a telephone type 2-way communication system. An example of current PDAs is the Apple Newton. The PDA is approximately 4" x 8" x 1" and weighs approximately one pound. The single unit price of the base unit is currently less than $600. The PDA utilizes a touch screen for input and output and has no moving parts. PCMCIA cards are currently available for normal telephonic modem, cellular phone, and Global Positioning System (GPS) modes of communication. The GPS system is down link only but can serve two very critical functions. The first is geolocation of the unit while taking very little space or weight in a team's operational kit. For Example, Ball Aerospace currently manufactures a GPS antenna that is 2" x 1" x .1" and weighs less than a tenth of an ounce. This is completely adaptable to the concept being discussed here. Programming the PDA to receive the GPS signal and allowing the operator to display the appropriate map centered on the location is elementary. Prior to entering the operations area the appropriate CD-i disk has been selected, and the

operator, by using the fingertip mouse, merely moves the visual map to the appropriate coordinates. GPS accuracy is shown in the diagram in Figure 1 and can be seen to be superior to any current mapping methodology.

THE SIX BASIC LEVELS OF GPS ACCURACY

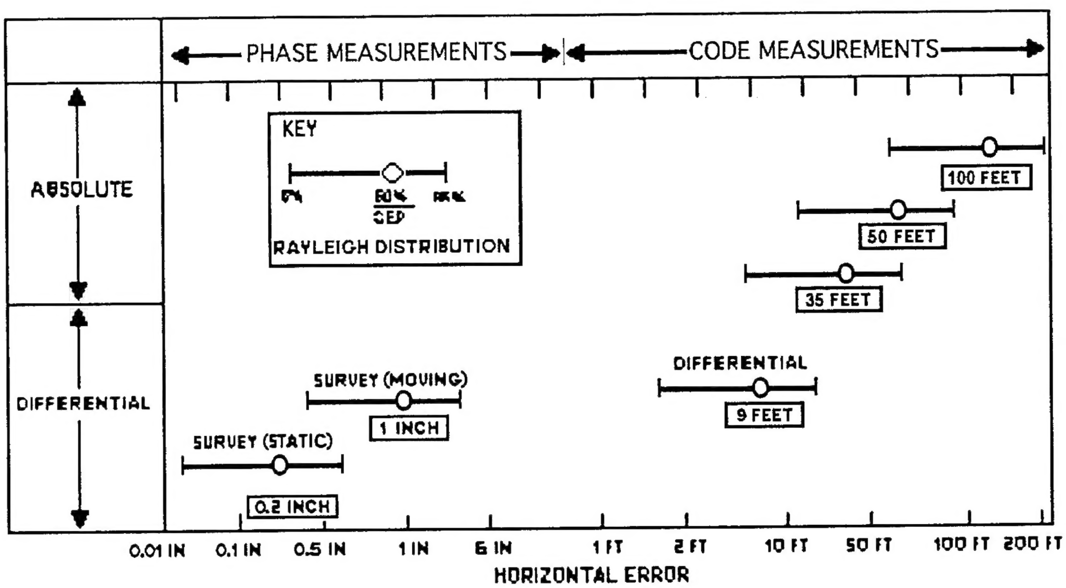

Figure 1. GPS Accuracy[1]

To avoid capture and use by hostile forces, a thermite pad can be placed on the back of the device and ignited at need to completely destroy the CD-i and PDA.

It can be seen from this diagram that Differential-Phase measurements may be made during motion at resolutions of one inch. This is certainly sufficient for any operational scenario discussed in this report. The GPS signal is a known entity, easy to

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1 Logsdon, Tom: The Navstar Global Positioning System:Van Nostrand Rheinhold: 1992.

acquire, with known, sophisticated algorithms for processing. The reception process is illustrated in Figure 2. It can be extrapolated to other methodologies.

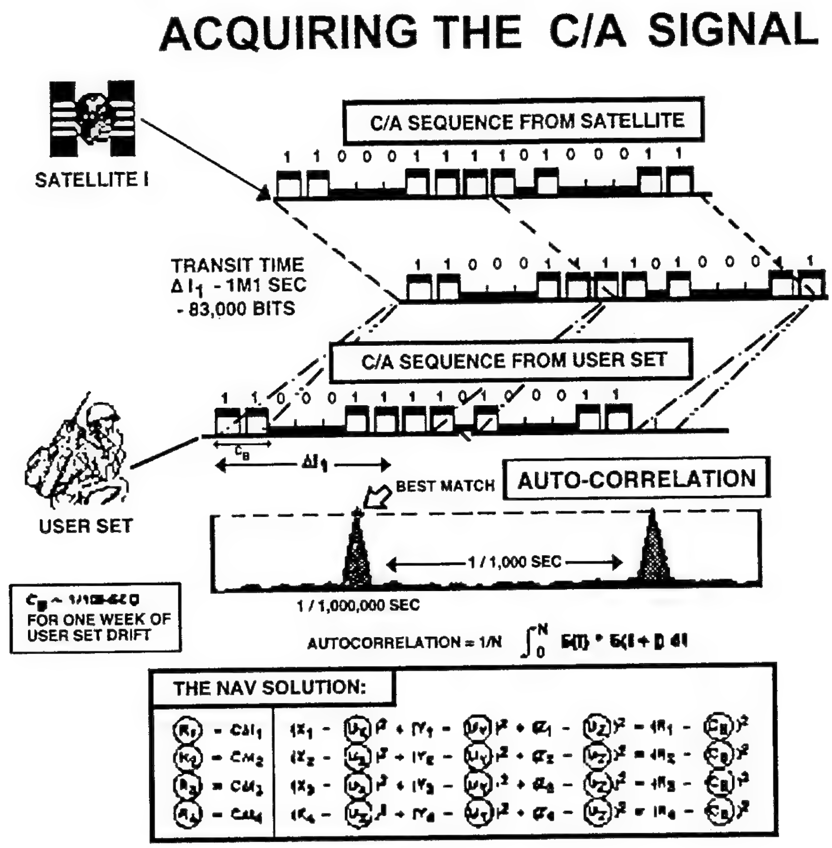

Figure 2. GPS Signal Acquisition[2]

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[2]Logsdon, Tom: The Navstar Global Positioning System:Van Nostrand Rheinhold: 1992.

There is also an additional reason to use the GPS signal. We have only talked about geolocation from the signal. We also want the capability to transmit intelligence data. This could be achieved with cooperation of agencies involved in GPS data transmission. The diagram in Figure 3 shows a typical GPS bit stream.

THE CONTENT OF THE GPS DATA STREAM

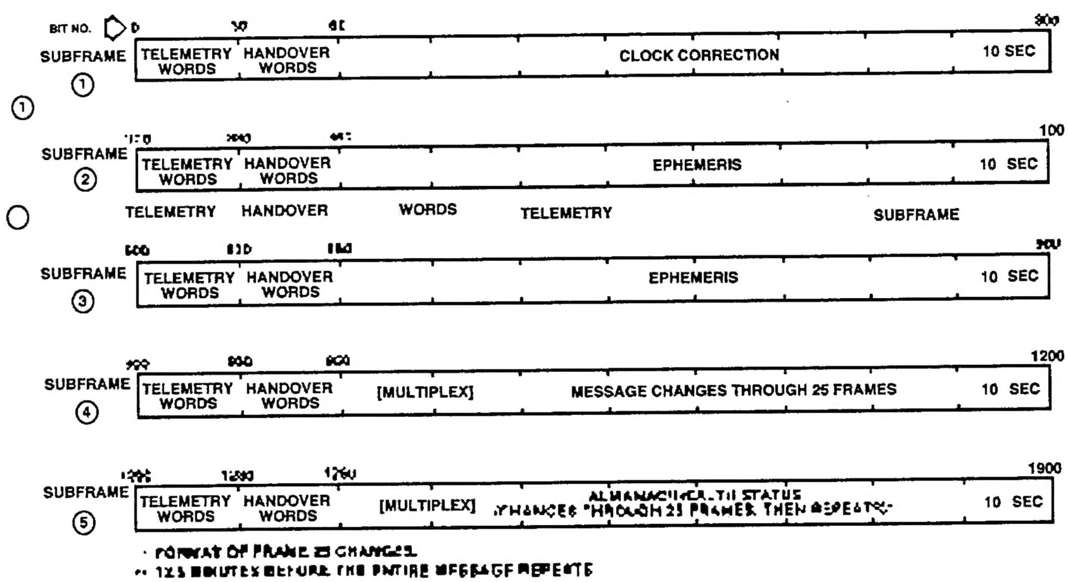

Figure 3. Content of the GPS Data Stream[3]

It can seen in sub frames 4 and 5 that there are words that could be utilized for transmission of intelligence data such as location and type of obstruction, or location and type of troop concentrations. Since there are many available methods of communication with a

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[3]Logsdon, Tom: The Navstar Global Positioning System:Van Nostrand Rheinhold: 1992.

PDA, several of which are available off the shelf, this will not be discussed further, but will be discussed as an accepted part of the design. It should be noted however that with little adaptation, it may be possible to utilize a packet transmission method that would use a tight beam to known overhead collectors, thereby allowing true real-time, two-way communication with little chance of detection.

The screen of the CD-i would show a background of the selected geographical area. This would be manually selected by the operator or a set of related maps could be selected automatically through GPS information. The operator could scroll the map within the date set available. At this point additional intelligence mapping data could be read into the CD-i and overlaid on the map being displayed. This updated and current input map would be a compilation of the most current intelligence data. There is an I/O port in the rear of the CD-i unit which allows for the in port of this data. The actual receiver and antenna units are available commercially to achieve the desired results, what does not exist is the interface to connect the receiver to the CD-i player. This interface would need to be developed and the capabilities of the CD-i further exercised to determine the ultimate functional capabilities of CD-i in being the solution to this problem.

Phase 2 of this Small Business Innovation Research Program will be, if contracted, to purchase the equipment and take the above concept to the next level of definition by attempting to complete the data connections, as defined, to both the PDA and CD-i devices.

A typical operational scenario then would be as follows:

H-24 hours:

Enroute briefing of team on operational scenario including the reception of current intelligence data on the CD-i player. Discussion of objectives and ingress and egress routes and methods. Allocation of weapons and collection tools.

H-6 hours:

Equipment prep continues. New batteries into equipment. Disks with maps of operational area removed from storage pouch. Each team member is assigned specific functions. Dissemination of function permits maximum acquisition of data even if team members are lost during the operation. Equipment, including CD-i's and PDAs, are tested by team members, and the newest intelligence is downloaded and stored in the system.

H-2 hours:

Equipment is sealed into vacuum packages. Thermite pads are attached and igniters passed to each team member.

H-1 hour:

Final check of equipment and weapons. Final check of all equipment and buddy's equipment. Final intel check on CD-i player.

H-hour:

Mount up in SDV. Depart mother ship. Navigation by SDV operator utilizing current itelligence data.

H+1 hour:

Arrival at embarkation point. Begin operational activity. Operator displays map on CD-i. Receiver is made functional and updated intelligence data is read in and overlaid on the CD-i display. PDAs are used to verify exact location. Team moves inland and observes troop movements and emplacements. Team performs current assigned task. Team moves back to beach.

H+8 hours:

Team meets SDV and departs for rendezvous with mother ship. Navigation by SDV operator with PDA backup.

H+9 hours:

Team arrives at mother ship and proceeds to debrief after weapons and diving check-in.